Canadian Patent Database

04/06/2000 - 14:09:07

(12) **Patent:** (11) **CA 836117**

(54) ELECTRIC ROAD SURFACE HEATERS

(54) ELECTRIC ROAD SURFACE HEATERS

View or Download Images

(72)	Inventors (Country):	**HERBERT PFERSCHY** (Not Available)
(73)	Owners (Country):	**HERBERT PFERSCHY**
(71)	Applicants (Country):	
(74)	Agent:	
(45)	Issued on:	**Mar. 3 , 1970**
(22)	Filed on:	
(43)	Laid open on:	
(52)	Canadian Class (CPC):	**309/3**
(51)	International Class (IPC):	**N/A**
	Patent Cooperation Treaty (PCT):	**No**
(30)	Application priority data:	**None**
	Availability of licence:	**N/A**
	Language of filing:	**Unknown**

ABSTRACT:

CLAIMS: Show all claims

*** Note: Data on abstracts and claims is shown in the official language in which it was submitted.

The invention relates to surface regions subject to strong m chanical stresses r considerably varying atmospheric conditions such as roads, airport runways, bridges and other traffic areas, using electric resistance heating elements.

It has been proposed to use the heat developed by electric current in resistance elements to heat traffic areas such as roads, bridges, runways, parkings, and the like. This has been achieved by providing heating cables and grids in the pavement; these have, however, the disadvantage of a non-uniform release of heat.

The present invention provides surface regions of the type discussed comprising an electrically conductive concrete layer. The invention has the advantage that the heating element is able to support traffic on the surface. Since concrete normally used has a very high electric resistivity, it is necessary to add admixtures ensuring a satisfactory conductivity for electrical energy even after the concrete has set.

A satisfactory conductivity can be achieved in the concrete by suitable chemical admixtures such as salts, for instance NaCl, or acids, for instance hydrochloric acid. The chemical admixtures mentioned above can be introduced into the concrete using, for instance, a system of tubes embedded in the concrete layer and provided with numerous openings through which the chemical admixtures in question are forced in a liquid state. In this case it is recommended to seal the concrete layer with a coating inhibiting evaporation.

The conductive concrete layer requires connecting electrodes to feed the heating current. The shape and arrangement of the connecting electrodes can be varied. By way of example plate electrodes are appropriate, the electrode plates being applied to the surface of the concrete layer or being embedded in the concrete layer. Instead of plate electrodes, bar-shaped electrodes, or wires serving as electrodes, can be used which are incorporated in the conductive concrete layer. Moreover, wire grids, wire gauzes or metal foils can be used as electrodes and applied to the concrete layer or embedded therein. The arrangement of th electrodes can b conceived such that the

lectrical heating curr nt flows substantially parall l to the plane of the traffic area being heated or perpendicular theret .

Because the conductivity is electrolytic (ionic), alternating current must be used as a heating current in order to prevent electrolytic decomposition as far as possible. In this instance it is also useful to arrange the electrodes such that they can be replaced and/or cleaned, if need be.

It has already been mentioned that it is known to make use of the heat developed by electric current in resistance elements in order to heat traffic areas. In the prior art, the heating elements were buried rather deeply below the surface in order to protect them against mechanical damage. This type of installation necessitates permanent heating of the traffic area since - owing to the unfavourable position of the heating element - it proves impossible to heat the traffic area in a short time period, because the heat required and the losses are too high because of the great depth in which the elements are installed. In such cases, heating controlled by atmospheric conditions proves impossible because of the inertia of the plant. To achieve an economic operation of such a device it is, however, necessary that the heating be controlled by atmospheric conditions.

Therefore, a further object of the invention consists in designing a surface region allowing rapid heating of the surfaces and ensuring that the major part of the heat produced is conducted toward the surface so that the device is able to operate with good efficiency and special insulating layers below the heating element or elements are unnecessary.

This is obtained, according to the invention, by providing a relatively thin surface region which is resilient or impact resistant and highly wear resistant, and arranging an electric resistance heating element in the surfacing and/or immediately below the surfacing.

By "relatively thin surface region" is meant a surface region the thickness of which is of the order of 50 mm and below, preferably below 12 mm. The terms "impact resistant" or "resilient" and "highly wear resistant" can be defined referring to a definite standard reference material such as concrete B 300 (c mpressiv strength 300 kg/cm^2) acc rding to DIN 1047, 1045 with a

granulation of 0 - 30 of the aggregates and with standard Portland cement 275 according to DIN 1164 as a binding agent. Highly wear resistant in the sens of the invention is then a surface region having at least the wear resistance of the reference material, but preferably a wear resistance amounting to twice or more of this wear resistance. Moreover, a surface region is impact resistant or resilient in the sense of the invention, if it exhibits at least twice, but preferably more of the impact strength or resilience of the reference material, the materials being tested, for instance, with a ball impact hardness tester.

A surface region which is impact resistant or resilient and highly wear resistant in this sense can be a relatively thin layer and yet the heating element placed in the surface region itself or immediately below the same will be satisfactorily protected. This allows the heating element to be placed very near the surface of the road, etc. being heated so that the distances being covered by the heat are very short, and the traffic area can be heated within a very short delay and the atmospheric control can be used with advantage.

The highly wear resistant and impact resistant or resilient surface region will generally be composed of binding agents and aggregates, further admixtures being added, if need be. Examples of suitable binding agents are cement of maximum quality (quality Z 375, Z 475 according to DIN 1164), aluminous cement, magnesia and plastics. Standard cement of the quality Z 275 can only be used with admixtures as a binding agent. The aggregates used are generally of mineral nature such as quartz, bauxite fines or ores. The admixtures apart from the aggregates, can be what are called chemical admixtures, such as plastics, or mineral admixtures, such as copper, slags or corundum. The indicated binding agents, aggregates and admixtures can be combined arbitrarily, provided that the final product is highly wear resistant and impact resistant or resilient. These properties are obtained best in that the surfacing layer consists of binding agents and of aggregates, the binding agents at least partially consists f plastics. If lectrically conductive substances are used as aggregates r admixtures, th surface region itself can

serve as a conductor for the h ating current or at least render it possible that the heat produced in the heating element prop r is quickly conducted t the surface, since according to the rule of Wiedemann-Franz the thermal conductivity of a material is proportional to its electrical conductivity.

A further suitable surface region is a plastic layer with fine gravel rolled in as a protection against skidding.

The invention includes the following embodiments of the electric resistance heating element embedded according to the invention in the surfacing itself or provided immediately below the surfacing: metal foils, metal coatings, gauzes composed at least partly of metallic filaments, cables or wires, and wire grids. Moreover, a concrete layer rendered sufficiently conductive by suitable admixtures such as salts or acids or conductive ores can be provided as a heating element immediately below the surfacing.

The operating voltage for the heating elements (metal foils, metal coatings, gauzes, cables, wire grids and wires) will generally depend on the nature of the traffic area being heated; it is possible to operate the installation with a low voltage of about 40 – 50 volts. Under normal conditions the heating capacity (connected load) will be about 200 va/m^2. If the installation is very large, the use of a low voltage safe for man and animal necessitates a large dimensioning of the feeds. It is true that this disadvantage can be overcome to a certain degree by providing several transformers, but it proves much more convenient to apply an operating voltage above 40 - 50 volts, preferably above 110 volts. To prevent any risk in this instance all installations of this type will be operated with highly sensitive safety circuits known in themselves and be insulated efficiently.

The safety circuits or safety measures considered are, e.g.: fault-current protective circuits; protective transformers or generators insulated from the ground; current reduction triggers; covering or enveloping of the insulation of the heating elements with an electrically conductive grounded material; suitable arrangement and dimensioning of the heating elements to keep the step voltage low, insulati n around the traffic area; insulation surfacing, preferably c nsisting of wear r sistant and impact resistant material. Evi-

dently it is possible t use several f the individual safety circuits and measures indicated abov at the same time, or t combine them with each other.

In the following, the above-mentioned safety measure of the fault-current circuit will be described in detail, since it is of special importance in connection with the present field of application. In this case, an electric safety circuit is provided at the conductor inlet which disconnects the current feeds in a manner known in itself by means of the leak current occurring on damage or earth-leakage in the system, before this leak current reaches the permissible tolerance value for man and animal. The upper limit of this leak current is defined by the permissible tolerance for man and domestic animal and is about 20 - 40 milliamp. When the leak current reaches this limit, the current supply must be interrupted so rapidly that any damage to man or animal is prevented. For this, empirical values are available which are incorporated into safety rules by law. Absolute values are not completely identical in the different countries. Since the upper limit of the reaction time is about 200 millisec, disconnection by the leak current switch must be effected at about 20 - 40 milliamp within a maximum delay of 200 millisec.

The operating system of the safety switch can be chosen arbitrarily. Tests have shown that with a three-phase power current connection the above-mentioned requirements are fully met by an inductive fault-current protective switchgear. With this fault-current protective switch the leak current is determined by means of a totalizing current transformer. The current feeds are wound as a primary winding round an iron core carrying a secondary winding. As long as the heating cable is not defective, the total current in the current transformer equals zero. If the heating cable becomes defective, the total current in the primary winding is no longer zero and thus a current is induced in the secondary winding which triggers a switch or contactor via a highly sensitive relay. The sensitivity and the time of response can be adjusted in a relatively simple way to requirements. It may become necessary, if very large areas are involved, to divide the total area into sub-areas and each sub-area must be provided with a separat current supply and safety switch. Sinc , however, with modern materials very good insulati ns can be achieved,

even with 100% moisture, such a measure will always remain an xception.

With a view to the fact that the heating elements are arranged within a regi n of possible mechanical destruction, the safety measur s must satisfy particularly rigorous conditions, but with the present state of technology this is possible without difficulty.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. Surface regions subject to strong mechanical stresses or considerably varying atmospheric conditions, such as roads, airport runways, bridges or other traffic areas, comprising a foundation layer and at least one coating covering said foundation layer, said coating comprising at least one layer of electrically conductive concrete and being adapted for connection to a source of electrical energy, said electrically conductive concrete layer containing admixtures causing an electrolytic (ionic) conductivity.

2. Surface regions as claimed in Claim 1 wherein a tubular system with numerous openings is embedded in said electrically conductive concrete layer through which a liquid rendering said concrete layer electrolytically conductive can be pressed into said concrete layer.

3. Surface regions as claimed in Claim 2 wherein said electrically conductive layer is covered with a sealing layer inhibiting evaporation.

4. Surface regions subject to strong mechanical stresses or considerably varying atmospheric conditions, such as roads, airport runways, bridges or other traffic areas, comprising a foundation layer and a relatively thin, impact resistant and highly wear resistant surfacing layer and an electric resistant heating element being arranged between said foundation layer and said surfacing layer and being adapted for connection to a source of electrical energy the surfacing layer consisting of binding agents and of aggregates wherein the binding agents consist at least partially of plastics.

5. Surface regions subject to strong mechanical stresses or considerably varying atmospheric conditions, such as roads, airport runways, bridges or other traffic areas, comprising a foundation layer and a relatively thin, impact resistant and highly wear resistant surfacing layer and an electric resistant heating element being embedded in said surfacing layer and being adapted for connecti n to a sourc f electrical energy, the surfacing layer consisting f binding agents and of aggregates, the binding agents consisting

D

at least partially of plastics.

6. Surface regions as claimed in Claim 4 wherein said surfacing layer consists of binding agents and of aggregates.

7. Surface regions as claimed in Claim 5 wherein said surfacing layer consists of binding agents and of aggregates.

8. Surface regions as claimed in Claim 4 wherein said surfacing layer consists of binding agents and of aggregates and of admixtures.

9. Surface regions as claimed in Claim 5 wherein said surfacing layer consists of binding agents and of aggregates and of admixtures.

10. Surface regions as claimed in Claim 6 or 7 wherein said binding agents mainly consist of aluminous cement.

11. Surface regions as claimed in Claim 6 or 7 wherein said binding agents mainly consist of magnesia.

12. Surface regions as claimed in Claim 6 or 7 wherein said binding agents mainly consist of plastics.

13. Surface regions as claimed in Claim 6 or 7 wherein said aggregates mainly consist of quartz.

14. Surface regions as claimed in Claim 6 or 7 wherein said aggregates consist of bauxite fines.

15. Surface regions as claimed in Claim 6 or 7 wherein said aggregates consist of ores.

16. Surface regions as claimed in Claim 8 or 9 wherein said admixtures consist of copper.

17. Surface regions as claimed in Claim 8 or 9 wherein said admixtures consist f slags.

18. Surface regi ns as claimed in Claim 8 or 9 wherein said admixtures consist f corundum.

19. Surface regions as claimed in Claim 8 or 9 wherein said admixtures consist of plastics.

20. Surface regions as claimed in Claim 4 or 5 wherein said surfacing layer is a plastic layer.

21. Surface regions as claimed in Claim 4 or 5 wherein said surfacing layer is a plastic layer with fine gravel rolled-in.

22. Surface regions as claimed in Claim 4 or 5 wherein said surfacing layer is a plastic layer provided with reinforcing laminates.

23. Surface regions as claimed in Claim 4 or 5 wherein said surfacing layer consists of rapid hardening cement.